

5.11.1.2 Normal Operations

Potential impacts to public health from normal operations include impacts from atmospheric releases of radionuclides and chemicals from solid waste management operations. Radiation doses for workers involved with waste management operations are also evaluated.

Alternative Group A involves operations that may result in routine releases of radionuclides and chemicals to the atmosphere. These operations include waste package verification, treatment, and packaging at the Waste Receiving and Processing Facility (WRAP), treatment and packaging of waste at the modified T Plant Complex; and treatment of leachate from mixed low-level waste (MLLW) trenches using pulse driers. The annual releases have been estimated for each year of operation for the facilities involved in this alternative. Details of the release calculations are presented in Appendix F, Section F.1.

5.11.1.2.1.1 Health Impacts from Routine Radionuclide Releases

Tables 5.27, 5.28, and 5.29 display the calculated doses and health impacts to non-involved workers and the public from routine atmospheric releases of radionuclides for the Hanford Only, Lower Bound, and Upper Bound waste volumes, respectively. The tables present the maximum annual dose to the non-involved workers and the public, the cumulative dose to the public, and the associated risk of LCF for these exposures occurring during the period covered by Alternative Group A. Given that the cancer risk estimates and doses are small in comparison to regulatory limits,^(a) no adverse health impacts would be expected from radionuclide releases.

5.11.1.2.1.2 Health Impacts from Chemical Releases

Releases of chemicals to the atmosphere could occur from the same waste processes involving radionuclide release when wastes with hazardous chemicals are involved. The potential health impacts from chemical releases to the atmosphere are presented in Table 5.30 for all waste volumes. The results for the Hanford Only waste volume are the same as those for the Lower Bound waste volume because the processing volumes for mixed waste streams are nearly identical for both cases (only mixed wastes contain chemicals that may be released to the atmosphere). Because the peak hazard quotients are all less than 1, and because the cancer risk estimates are small, minimal adverse health impacts would be expected from chemical releases. Chemical releases from leachate treatment using a pulse drier are believed to be small compared to other processing (for example, WRAP) and are not included in the analysis of chemical health impacts.

5.11.1.2.1.3 Worker Occupational Radiation Exposure

The radiation dose received by workers involved with waste operations is estimated using historical exposure data for the facilities involved in the alternative (FH 2003). The exposure to involved workers is summarized in Table 5.31 for the Hanford Only waste volume, in Table 5.32 for the Lower Bound

(a) The maximum annual radiation dose presented in this section may be compared to the regulatory limit of 10 mrem/year (DOE 1993; WAC 246-247; 40 CFR 61).

waste volume, and in Table 5.33 for the Upper Bound waste volume. The worker category “Other” includes engineers, maintenance and construction personnel, and general support staff (for example, administrative and clerical workers). All estimated radiation doses to workers are well below regulatory limits.^(a)

Table 5.27. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group A, Hanford Only Waste Volume

Exposed Group	Exposure Scenario ^(a)	Facility	Lifetime Dose ^(b) (mrem)	Probability of an LCF ^(c)	Maximum Annual Dose	
					Year	mrem
Worker Onsite (non-involved)	Industrial	WRAP	1.2E-03	7E-10	2004	1.3E-05
		Modified T Plant Complex	4.8E-01	3E-07	2003	3.9E-02
		Leachate Treatment ^(d, e)	4.3E-07	3E-13	2026	3.2E-09
MEI Offsite	Resident Gardener	WRAP	9.9E-05	6E-11	2004	1.1E-05
		Modified T Plant Complex	1.5E-03	9E-10	2003	1.1E-04
		Leachate Treatment	3.0E-11	2E-17	2026	1.6E-12
		Total	1.6E-03	1E-09	2003	1.2E-04
			(person-rem)	Number of LCFs ^(g)	Year	(person-rem)
Population ^(f)	Population within 80 km (50 mi)	WRAP	9.1E-03	0 (5E-06)	2004	7.4E-04
		Modified T Plant Complex	1.4E-01	0 (8E-05)	2003	7.4E-03
		Leachate Treatment	2.1E-09	0 (1E-12)	2026	1.1E-10
		Total	1.5E-01	0 (9E-05)	2003	8.1E-03
(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.						
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.						
(c) LCF = latent cancer fatality.						
(d) Leachate treatment is a pulse drier operation.						
(e) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.						
(f) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.						
(g) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).						

(a) The annual limit for occupational exposures is 5000 mrem/year (10 CFR 835).

Table 5.28. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group A, Lower Bound Waste Volume

Exposed Group	Exposure Scenario ^(a)	Facility	Lifetime Dose ^(b) (mrem)	Probability of an LCF ^(c)	Maximum Annual Dose	
					Year	mrem
Worker Onsite (non-involved)	Industrial	WRAP	1.4E-03	9E-10	2004	1.6E-04
		Modified T Plant Complex	5.8E-01	3E-07	2003	4.8E-02
		Leachate Treatment ^(d, e)	1.3E-07	8E-14	2026	7.4E-09
MEI Offsite	Resident Gardener	WRAP	1.2E-04	7E-11	2004	1.3E-05
		Modified T Plant Complex	1.7E-03	1E-09	2003	1.2E-04
		Leachate Treatment	6.8E-11	4E-17	2026	3.6E-12
		Total	1.8E-03	1E-09	2003	1.3E-04
			(person-rem)	Number of LCFs ^(g)	Year	(person-rem)
Population ^(f)	Population within 80 km (50 mi)	WRAP	1.1E-02	0 (6E-06)	2004	8.8E-04
		Modified T Plant Complex	1.6E-01	0 (9E-05)	2003	8.5E-03
		Leachate Treatment	6.2E-09	0 (4E-12)	2026	2.5E-10
		Total	1.7E-01	0 (1E-04)	2003	9.4E-03
(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.						
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.						
(c) LCF = latent cancer fatality.						
(d) Leachate treatment is a pulse drier operation.						
(e) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.						
(f) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.						
(g) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).						

Table 5.29. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group A, Upper Bound Waste Volume

Exposed Group	Exposure Scenario ^(a)	Facility	Lifetime Dose ^(b) (mrem)	Probability of an LCF ^(c)	Maximum Annual Dose	
					Year	mrem
Worker Onsite (non-involved)	Industrial	WRAP	2.2E-03	1E-09	2004	1.9E-04
		Modified T Plant Complex	8.9E-01	5E-07	2006	7.2E-02
		Leachate Treatment ^(d, e)	1.9E-07	1E-13	2026	1.1E-08
MEI Offsite	Resident Gardener	WRAP	2.1E-04	1E-10	2004	1.6E-05
		Modified T Plant Complex	2.3E-03	1E-09	2006	1.7E-04
		Leachate Treatment	8.4E-11	5E-17	2026	4.5E-12
		Total	2.5E-03	1E-09	2006	1.9E-04
			(person-rem)	Number of LCFs ^(g)	Year	(person-rem)
Population ^(f)	Population within 80 km (50 mi)	WRAP	1.9E-02	0 (1E-05)	2004	1.1E-03
		Modified T Plant Complex	2.2E-01	0 (1E-04)	2006	1.5E-02
		Leachate Treatment	7.6E-09	0 (5E-12)	2026	3.1E-10
		Total	2.4E-01	0 (1E-04)	2006	1.6E-02
(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.						
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.						
(c) LCF = latent cancer fatality.						
(d) Leachate treatment is a pulse drier operation.						
(e) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.						
(f) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.						
(g) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).						

Table 5.30. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Chemicals – Alternative Group A, All Waste Volumes

Volume	Exposed Group	Exposure Scenario ^(a)	Facility	Risk of Cancer Incidence ^(b)	Peak Annual Hazard Quotient ^(c)
Hanford Only and Lower Bound	Worker Onsite (non-involved)	Industrial	WRAP	1.2E-09	8.9E-05
			Modified T Plant Complex	3.2E-08	2.3E-03
	MEI Offsite	Gardener	WRAP	5.6E-11	3.4E-06
			Modified T Plant Complex	6.1E-11	7.2E-06
			Total	1.2E-10	1.1E-05
	Population	Population within 80 km (50 mi)	WRAP	0 (5E-06) ^(d)	NA ^(e, f)
			Modified T Plant Complex	0 (6E-06) ^(d)	NA
			Total	0 (1E-05) ^(d)	NA
Upper Bound	Worker Onsite (non-involved)	Industrial	WRAP	5.3E-09	6.9E-04
			Modified T Plant Complex	1.8E-07	2.4E-03
	MEI Offsite	Gardener	WRAP	2.3E-10	2.5E-05
			Modified T Plant Complex	2.0E-10	2.5E-05
			Total	4.2E-10	5.0E-05
	Population	Population within 80 km (50 mi)	WRAP	0 (2E-05) ^(d)	NA ^(e, f)
			Modified T Plant Complex	0 (2E-05) ^(d)	NA
			Total	0 (4E-05) ^(d)	NA
(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.					
(b) The individual risk of cancer incidence is evaluated for the exposure duration defined for the given exposure scenario starting in the year that provides the highest total impact.					
(c) Hazard quotients are reported for the year of highest exposure.					
(d) Population risk from cancer is expressed as the inferred number of fatal and non-fatal cancers in the exposed population over the lifetime of the population from intakes during the remediation period. The actual value must be a whole number (cancers).					
(e) Hazard quotients are designed as a measure of impacts on an individual and are not meaningful for population exposures.					
(f) NA = not applicable.					

Table 5.31. Occupational Radiation Exposure – Alternative Group A, Hanford Only Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE) ^(a)	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCF ^(c)
LLW and MLLW Trenches	2002- 2046	Operator	14	54	34	0 (2E-02)
		RCT ^(b)	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300 ^(d)	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002- 2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002- 2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033- 2039	Operator	9	18	1.2	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	21	13	1.9	0 (1E-03)
Modified T Plant Complex	2002- 2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033- 2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (2E-03)
	2013 – 2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff ^(e)	2002-2019	Operator	15	34	9.2	0 (6E-03)
		RCT	12	35	8	0 (5E-03)
	2020-2026	Operator	5	34	1.2	0 (7E-04)
		RCT	3	35	0.7	0 (4E-04)
	2027-2044	Operator	1	34	0.6	0 (4E-04)
		RCT	1	35	0.6	0 (4E-04)
Pulse Driers	2026- 2077	Operator	0.4	54	1.1	0 (7E-04)
Total					765	0 (5E-01)
<p>(a) The number of workers is the average necessary for the facility during the indicated period.</p> <p>(b) RCT = radiation control technician.</p> <p>(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.</p> <p>(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.</p> <p>(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.</p>						

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Table 5.32. Occupational Radiation Exposure – Alternative Group A, Lower Bound Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE) ^(a)	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCF ^(c)
LLW and MLLW Trenches	2002- 2046	Operator	14	54	34	0 (2E-02)
		RCT ^(b)	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300 ^(d)	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002- 2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002- 2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033- 2039	Operator	9	18	1.2	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	21	13	1.9	0 (1E-03)
Modified T Plant Complex	2002-2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (2E-03)
	2013 – 2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff ^(e)	2002-2019	Operator	15	34	9.2	0 (6E-03)
		RCT	12	35	8	0 (5E-03)
	2020-2026	Operator	5	34	1.2	0 (7E-04)
		RCT	3	35	0.7	0 (4E-04)
	2027-2044	Operator	1	34	0.6	0 (4E-04)
		RCT	1	35	0.6	0 (4E-04)
Pulse Driers	2026-2077	Operator	0.8	54	2.2	0 (9E-04)
Total					766	0 (5E-01)
<p>(a) The number of workers is the average necessary for the facility during the indicated period.</p> <p>(b) RCT = radiation control technician.</p> <p>(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.</p> <p>(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.</p> <p>(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.</p>						

Table 5.33. Occupational Radiation Exposure – Alternative Group A, Upper Bound Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE) ^(a)	Average Dose Rate (mrem/yr)	Workforce Dose (Person-rem)	Workforce LCF ^(e)
LLW and MLLW Trenches	2002- 2046	Operator	14	54	34	0 (2E-02)
		RCT ^(b)	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300 ^(d)	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002-2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002-2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033-2039	Operator	9	18	1.2	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	32	13	1.9	0 (1E-03)
Modified T Plant Complex	2002-2032	Operator	20	9	5.5	0 (3E-03)
		RCT	18	13	7.4	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (2E-03)
	2013 – 2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff ^(e)	2002-2019	Operator	20	34	12	0 (7E-03)
		RCT	13	35	8.2	0 (5E-03)
	2020-2026	Operator	7	34	1.7	0 (1E-03)
		RCT	5	35	1.2	0 (7E-04)
	2027-2044	Operator	3	34	1.8	0 (1E-03)
		RCT	2	35	1.3	0 (8E-04)
Pulse Driers	2026-2077	Operators	1.2	54	3.3	0 (2E-03)
Total					774	0 (5E-01)
<p>(a) The number of workers is the average necessary for the facility during the indicated period.</p> <p>(b) RCT = radiation control technician.</p> <p>(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.</p> <p>(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.</p> <p>(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.</p>						

1 estimated health and safety impacts would be about 200 total recordable cases, 84 lost workday cases, and
2 about 2900 lost work days.

3 4 **5.11.1.3 Alternative Group B**

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6 Alternative Group B is similar to Alternative Group A except that use of commercial treatment
7 facilities would be minimized with construction of a new waste processing facility, instead of modifying
8 the T Plant Complex. New LLW and MLLW trenches would be constructed using the current design
9 instead of the wider, deeper trench designs. Alternative Group B would involve the same waste
10 processing and the same waste management approaches. The alternative includes the establishment of
11 necessary facilities for storage, inspection, treatment, and final disposal or shipment offsite for all
12 included waste streams. In addition, Alternative Group B includes the same sources, waste streams, and
13 volumes of waste as Alternative Group A.

14
15 As in Alternative Group A, all of the wastes would be removed from storage and treated as necessary
16 for disposal in the HSW disposal facilities or sent to the WIPP. After about 10 years, wastes would only
17 be held in storage for short periods of time to allow for characterization and evaluation prior to treatment
18 or disposal. Under Alternative Group B, the analyses use the Hanford Only, Upper, and Lower Bound of
19 forecasted disposal waste volumes for LLW and MLLW.

20 21 **5.11.1.3.1 Construction**

22
23 New construction activities are anticipated for HSW disposal facilities and the new waste processing
24 facility. The primary impacts from construction activities would be to air quality and injuries to
25 construction workers. No impacts to construction workers are expected from radiation and chemicals
26 because new construction activities would be performed away from areas of known contamination.
27 Impacts to non-involved workers (from other onsite activities) are expected to bound potential air quality
28 impacts to construction workers. Impacts from industrial accidents during construction are discussed in
29 Section 5.11.1.2.3.

30
31 The construction activities may involve emission of criteria pollutants from the use of combustion
32 engines and earthmoving activities. The potential impacts from these activities are described in
33 Section 5.2 and are summarized here. Impacts are measured by comparison of air concentrations at the
34 point of maximum potential public exposure. The analysis indicated that emissions of criteria pollutants
35 (including sulfur dioxide, carbon monoxide, nitrogen dioxide, and PM₁₀) from construction activities
36 would result in air concentrations below the regulatory limits. As a consequence, no health impacts
37 would be expected from these emissions.

38 39 **5.11.1.3.2 Normal Operations**

40
41 Potential impacts to public health from normal operations include air quality impacts from
42 atmospheric releases of radionuclides and chemicals from waste operations. Long-term impacts from
43 releases to groundwater from LLBGs are discussed in Sections 5.11.2 and 5.3.